

UPPER TRISHULI-1 HEP (216MW)			
Client	Doosan Heavy Industries & Construction		
DHI's Subcontractor	Power Construction Corporation of China		
REPLY COMMENT			
Subcontractor	Power Construction Corporation of China		
Incoming Document			
Title of the Document	Excavation and Initial Support Drawings of Investigation Tunnel for Powerhouse		
Document/Drawing No.	UT1-C-385-CVL-DG-65002-01 to 04	Revision	C
Review Document No.	TJ/UT1/OUT-25	Reviewed Note No.	RN-0038
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Outgoing Document			
Previous Reply No.	N/A	Previous Reply Date.	26.11.2021
Reply No.	RC-000X	Reply date	30.01.2022

General Comments

It is noted that the submitted documents are dated 26.11.2021, but they were received by the OE on 15.12.2021.

Most of previous comments of the reviewer were considered and were indicated in the drawings. Only some technical comments remained. There are several other comments, which refer to formalities, only. However, due to missing confirmation of the support through design calculations (e.g. rock bolt pattern, shotcrete thickness), the drawings cannot be approved. This is due to the fact that the support may still need meaningful adjustment.

General note: this modification also considers the support idea proposed in the stability calculation of surrounding rock, that is, different types of surrounding rock take different support measures according to different buried depths.

The drawings are marked and commented.

Drawing UT1-C-385-CVL-DG-65002-01, Rev. C

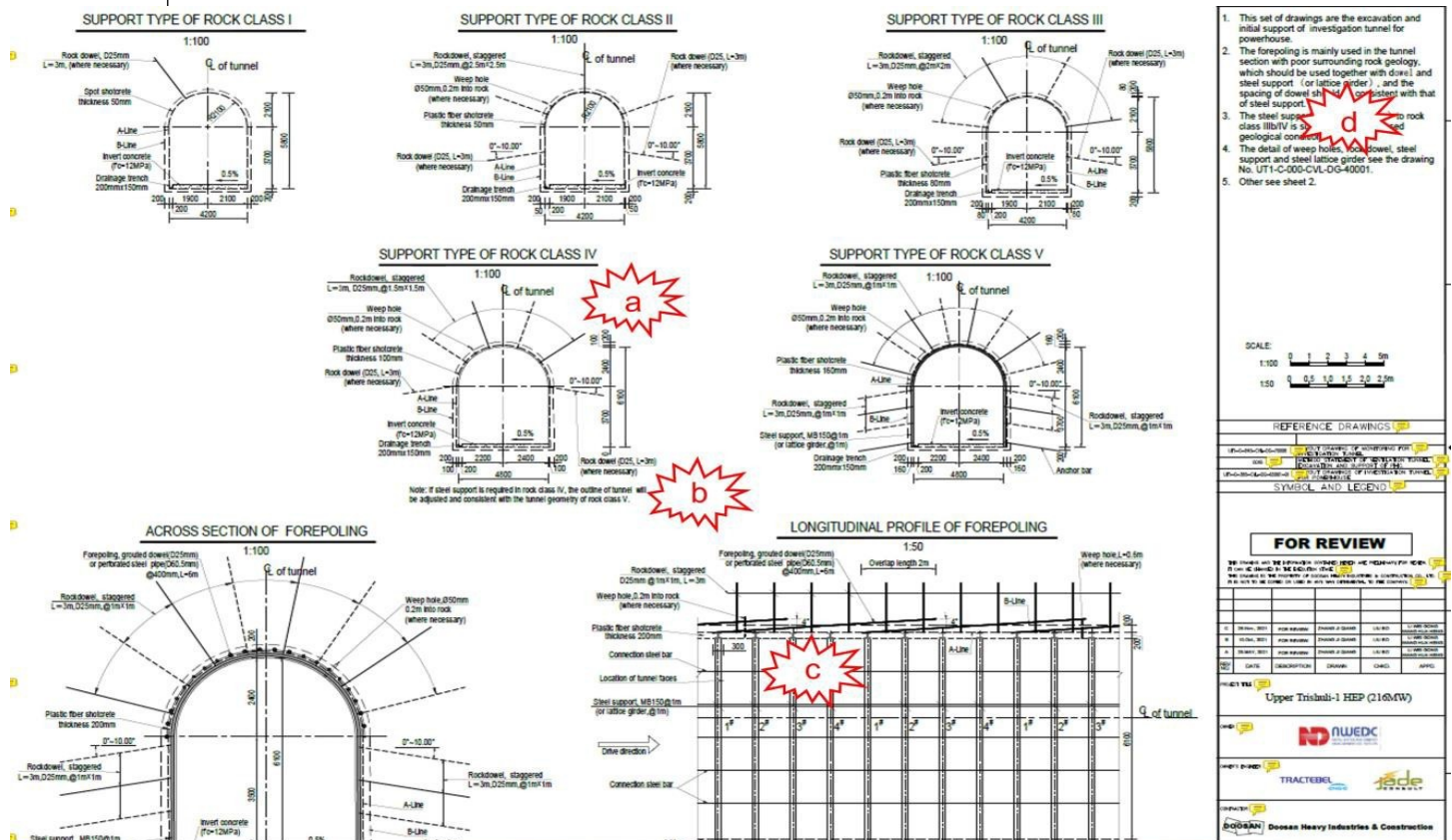
Support type	IIIb	IIIa			
	a		c	d	e
TUNNEL SUPPORT PATTERN					
Rock mass quality	40<Q	10<Q<10	7<Q<10	1<Q<4	Q<1
Support type	I	II	III	IV	V
Inner dimension(m)			8=0.2m, 8=0.2m		
Excavation span(m)	3	2	2	1.5	0.5~1
Maximum Unsupported Span for shotcrete application(m)		9	4	2	0.5~1
Maximum Unsupported Span for rock dowel installation(m)		6	2	1.5	0.5~1
Maximum Unsupported Span for steel support installation(m)					0.5~1
Excavation method			Blasting		
Shotcrete	No need	Plastic fiber shotcrete, f' c=21MPa, T=50mm	Plastic fiber shotcrete, f' c=21MPa, T=50mm	Plastic fiber shotcrete, f' c=21MPa, T=100mm	Plastic fiber shotcrete, f' c=21MPa, T=160mm
Rock dowel	D25, L=1m (where necessary)	D25, L=1m (where necessary)	D25, L=1m, 41m, 1.5m (alternately)	D25, L=1m, 41, 1.5m, 1.5m (alternately)	D25, L=1m, 41m, 1m (alternately)
weep hole			Weep hole, Ø50mm, 0.2m into rock (where necessary)		
Steel support					Steel support, M150x6m (or inline girder, #14)
Supplementary support				Forepoling grouted dowel, D25mm, L=6m (where necessary)	Forepoling grouted dowel, D25mm, L=6m, L=6m

Note: It is evident that the maximum unsupported span is a guideline, only, and needs continuous adjustment to the prevailing rock conditions and construction requirements at the spot.

- Support Type is purely speculative. Delete this row.
Reply ☐ Accept and delete.
- Shotcrete and dowels should be "spot dowels" and "spot shotcrete".
Reply: "spot dowels" and "spot shotcrete" have been indicated to the srpport type of rock class I.
- Class III is defined for $4 < Q < 10$. Revise. In Class III there is firstly shotcrete applied, then rock bolts. Therefore, maximum unsupported span for shotcrete is 2.0 m and for rock bolts it is 4.0 m. Revise. Length of weep holes shall be 300 m. Revise in all drawings. **When combining Class IIIa and IIIb to one Class III, which is certainly recommended, shotcrete thickness must be 100 mm, not 80 mm. Revise, also in the other drawings of this set.**
In Class IV there is firstly shotcrete applied, then rock bolts. Therefore, maximum unsupported span for shotcrete is 1.5 m and for rock bolts it is 3.0 m. Revise.
Reply: Accept and modified as th following :
For class III , maximum unsupported span for shotcrete is 2.0 m and for rock bolts it is 4.0 m,
For class IV , maximum unsupported span for shotcrete is 1.5 m and for rock bolts it is 3.0 m,
Length of weep holes is 300 mm.
- Steel support in Class IV is "as required".
Reply ☐ Accept, and has been modified in the tunnel support pattern.
- Excavation method shall be "blasting/mechanically" in Class IV and "mechanically" in Class V.
Reply ☐ Accept, and has been modified in the tunnel support pattern.
- Put the "Note: It is evident..." to the "Notes" of this drawing under Item 3.
Reply ☐ Accept, and the note has been shifted to the "NOTE" of drawing.

- a) It is unclear how the space between the ribs is filled of the Open Tunnel. Specify shotcrete thickness and reinforcement (wire mesh, wire mesh criss-cross, wire mesh with chicken mesh?).
Reply: Considering the safety and environment, and steel mesh is set around the steel arch and 260mm concrete is sprayed. Wire mesh Ø5.5mm, C/C 100mm and shotcrete 260mm.
- b) Same as a).
Reply: same as the above reply.
- c) Indicate that minimum thickness of shotcrete is 200 mm, otherwise the tunnel invert may become “wavy”.
Reply: Please note that there should be invert concrete but shortcrete, that is, the minimum thickness of invert concrete is 200mm.
- d) Provide number of Method Statement. Also, on the other drawings of this set.
Reply: 6
- e) Provide rock bolt pattern of Class III (IIIb) as rock class is already known to be Class IIIb.
Reply: Accept, and has been modified in the tunnel support pattern.

Drawing UT1-C-385-CVL-DG-65002-03, Rev. C



a) Rock dowels in the sidewalls of the tunnel in Class IV are mandatory. Indicate.

Reply: accept and has been modified.

b) Indicate in Class IV and Class V the contour of the concrete liner.

Reply: the contour of the concrete liner has been added in Class IV and Class V.

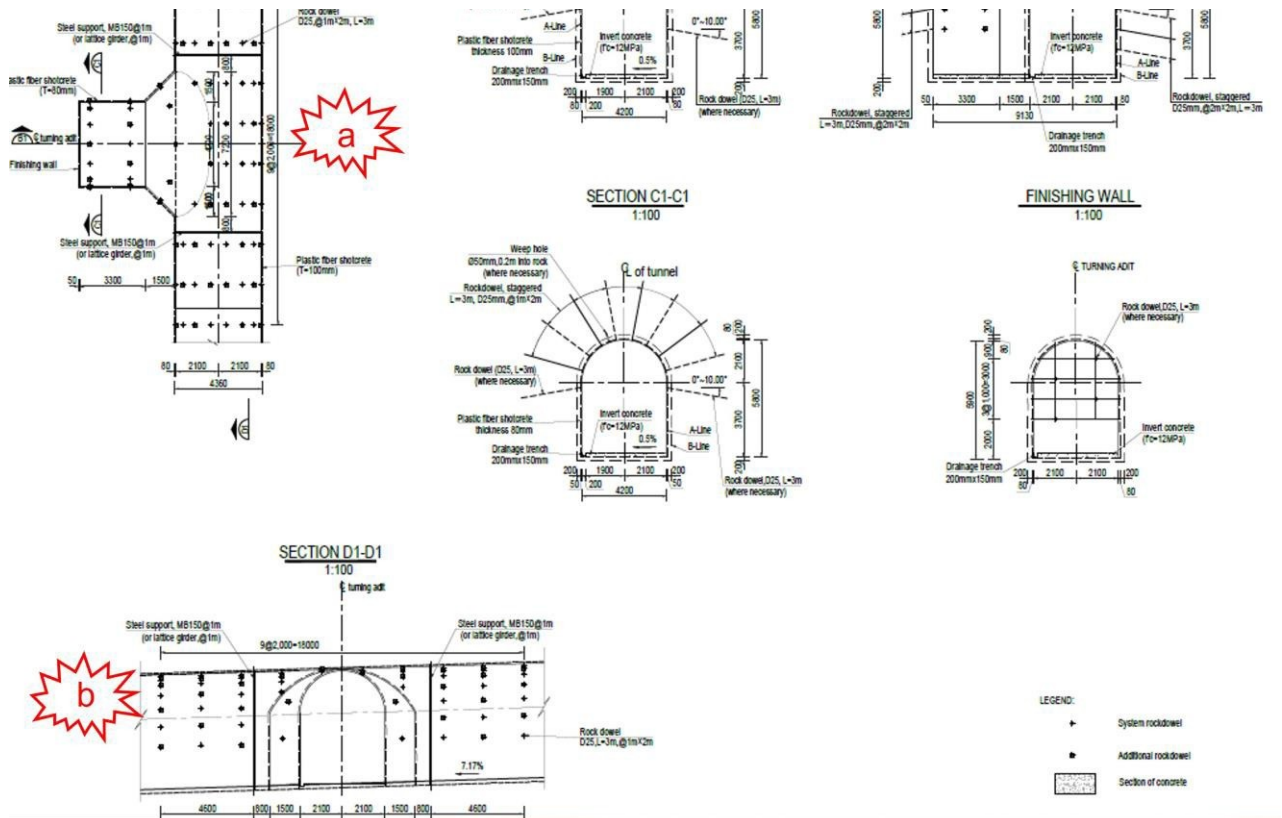
c) Provide a note, that the excavation profile may need to be adjusted to a "saw-tooth profile" and size of ribs/girders may also be adjusted.

Reply: accept and the note has been added below the section.

d) Item 3, there is no steel support in Class IIIb (or Class III). Revise.

Reply: the item 3 has been deleted, the support may be found in the table support pattern.

Drawing UT1-C-385-CVL-DG-65002-04, Rev. C



- a) The shotcrete thickness in the turning adit shall be 100 mm (= Class III). The shotcrete thickness shall be thicker in the actual junction. Revise to at least 120 mm. There is no spacing of steel support. There is only one steel rib at the beginning and one at the end of the junction. Clarify. The bolting pattern in the centre of the roof of the actual junction shall be at least as dense as elsewhere in the junction. Revise.

Reply: The shotcrete thickness has been modified.

Generally, the support is not required in rock class III. Because the sudden change of body shape, steel support can be considered, but one row is enough.

- b) Tunnel drive direction is always from left to right in drawings (= tunnel slopes to the right). Revise.

Reply: accept and modified